MAESTRO
Model Aircraft Electrical System Test and Ring Out
Version 1.1

Welcome to MAESTRO! Don't let its small size fool you, MAESTRO has many features that will help you insure your aircraft is ready for a safe flight, plus several features to help you diagnose problems and help you setup a new aircraft.

MAESTRO incorporates the latest in microcontroller technologies to provide you the following capabilities:

- Battery test
    - No load voltage monitoring
    - Loaded voltage monitoring
    - Calculation of battery cell impedance
    - Low voltage warning
    - Charge now error message
    - Visual Battery level indicator
    - Multiple voltage profiles
- High low battery voltage monitoring
- Pulse width monitoring
- Servo cycler
- Servo positioning
- Voltage recording
- Computer interface and programming application (requires serial interface)

MAESTRO can be configured to the needs of each pilot. The voltage alarm and warning levels are programmable as well as servo cycler positions; even the startup message can be customized to display your name and AMA number if you like. MAESTRO can be configured at the factory for you or with the addition of a low cost interface you can configure the parameters yourself.

MAESTRO is very simple to use! Only 1 button, 1 red light and a small display packaged in a small enclosure. Several operating modes are supported, to start MAESTRO simply connect it to your radio system, using the charge jack, and you will see the startup display and your systems no load battery voltage. Press the button to read the loaded voltage, press the button one more time and MAESTRO will calculate your battery packs cell impedance! If the battery voltage is below a user defined limit, MAESTRO will warn you that your batteries are getting low. If your batteries are below a critical limit, MAESTRO will tell you not to fly! MEASTRO will fit in your pocket, or your flight box making it easy to always have the tools you need to make sure it is safe to fly.

The battery load is configurable at the factory and several standard load values are available. Connecting cables are also configurable at the factory. The MAESTRO

always comes with both male and female connectors for added flexibility and support of servo cycling modes.

Operation:

MAESTRO is very simple to use. When power is applied the default mode is entered, this is set at the factory to be the voltage monitoring mode. This is the most commonly used mode but this default can be changed using the PC interface and configuration utility.

The operating mode can be changed when power is applied by following this simple procedure:

1.) Press the button and hold it down.
2.) Apply power to MAESTRO then in a few seconds release the button. This will result in the device powering up and allowing you to select the desired mode. The bottom line of the display will show the current mode.
3.) Press and release the button to advance through the list of all supported modes.
4.) When you see the mode you would like to use, press and hold the button for a few seconds, the bottom two lines of the display will blink indicating the mode has been selected.
5.) That's it, now you have selected your desired mode. The details of each mode are discussed in the following sections of this document.

After you have selected your desired mode MAESTRO will remain in this mode until you remove power.

Modes:

In the following section you will find a full description of each mode supported by the MAESTRO.

Voltage Test (Modes 1 and 2)

The voltage test mode is the default mode set at the factory and the primary use for MAESTRO. This mode is designed to test your systems battery voltage, first with no load and then with a load. This combination of test provides the pilot with valuable information that can be used to determine if adequate battery capacity remains to safely fly. After these two voltages are recorded, the battery packs impedance can then be calculated. This is one more piece of information that can assist you in determining battery condition. The following step-by-step procedure outlines how to use MAESTRO:

1.) Insert either the male of female connector into your systems charge jack.
2.) Observe the no-load battery voltage displayed on the bottom line of the display. If this voltage is below the low battery warning level you

will see a warning message on the first two lines of the display. If the voltage is below an error level, then you will see a message telling you not to fly! These limits can be configured at the factory or you can program MAESTRO yourself with a low cost PC interface. The battery capacity can also be monitored using the battery level gauge in the upper right side of the display.

3.) To record the loaded battery voltage, press the button one time and release. The red light will come on indicating the load has been applied and the display will indicate the loaded voltage. The warning message described in step two is also displayed in this loaded voltage test. After a short period (30 seconds is factory default) the load will be turned off and the battery impedance will be displayed, or you can press the button again to advance to the impedance mode.

That completes your battery level test. This procedure can be completed in less than a minute and then you can slip MAESTRO back in your pocket and fly!

MAESTRO has two voltage testing profiles. This allows you to define different parameters for each profile. To change the profiles hold the button down for 2 seconds and then release. This will change the profile and you will see the new profiles display and all parameters will automatically load. Mode 1 is defined as voltage profile A and mode 2 is voltage profile B.

V high low (Mode 3)

Voltage high low mode allows you to monitor your battery voltage while operating your model. This is very useful when diagnosing system problems. You can plug MAESTRO in between your servo and your receiver; the servo's operation will not be affected. The display will show the highest and lowest battery voltage seen. If you press the button then the high and low values will be set to the current voltage. Below is a list of a few useful tests you can perform with this function:

1.) Test for inadequate gauge wire used in servo extensions. This can be seen if the difference between the high and low voltages is large, say more that a volt.
2.) Detect servo binding. This will also cause a large voltage difference.
3.) You could even fly MAESTRO in your airplane to see what happens under flight loads.
4.) I'm sure you will think of many additional tests!

The minimum voltage that can be recorded is 2.7 volts. Voltage levels below this will cause MAESTRO to restart. The display will not be

visible below about 3.5 volts but the device will function, you just can't read the display.

PulseMonitor (Mode 4)

The pulse monitor mode enables the device to measure the pulse width data sent from the receiver to the servos. The servo position is determined by a pulse whose width varies from about 1 millisec to 2 millisec (.001 sec to .002 sec). The servo center position is around 1.5 millisec. With the device in this mode connect to any servo channel you would like to monitor. The bottom line of the display will show the pulse width in millisecs. As you move the transmitter stick you will see the width value change. This is a great diagnostic tool and here are a few tests you can do:

1.) Test the transmitter's ability to center. Is the width at gimbal center the same as you move the stick back and forth?
2.) Record a servos position as a function of pulse width. Match servos, or use as a servo diagnostic.
3.) Record the pulse width information of all of the servo limits to help you setup a new radio.
4.) Debug servo centering problems.

MAESTRO can measure the pulse width with a precession of 1 uSec, this is 0.000001 sec. This is equivalent to the 1024 resolution of high performance PCM radio systems!

Servo Cycle (Mode 5)

Servo Cycle mode allows you to control the position of a servo and cycle the servo between several programmed servo positions. MAESTRO comes from the factory with the following positions programmed in the cycle table:

1.) 1.000 mSec
2.) 1.500 mSec
3.) 2.000 mSec
4.) 1.500 mSec

The cycle table can contain a maximum of 10 positions. When in this mode a servo is connected to one of MAESTRO's connectors and a battery to the other. While in this mode, each time the button is pressed the servo position will advance from one programmed position to the next. When the end of the table is reached, the position is reset to the first entry in the table and the table is repeated. If the button is pressed and held for about 2 seconds then the table is automatically advanced every second until the button is pressed again.

Using the PC interface and programming utility you can define the positions and the amount of time to delay at each position when in the auto advance mode.

Srv Position (Mode 6)

This is the servo position mode and allows you to position a servo to any desired point. This is very useful in initial servo installation in your aircraft. To use this mode attach a servo to one of MAESTRO's connectors and a battery to the other. The bottom line of the display will show the pulse width being sent to the servo. To the far left on the bottom line you will see a + this indicates the servo position pulse width will advance when the button is pressed. To cause the servo position pulse width to decrease, press the button and release twice with a short delay between each button press. This will change the + to a – and back and forth. If you press the button one time the servo pulse width will increase (or decrease if a – is displayed) by only 1 uSec resulting in a very small servo movement. If you press and hold the button the servo pulse width will take 10 uSes steps and repeat until you let go of the button, this will result is rapidly moving the servo position.

Parameters (Modes 7 and 8)

When the parameters mode is selected MAESTRO will display a few of its key parameters. Below is an example display when this mode is selected:

Load R:	Load resistance in ohms is used to measure the loaded battery voltage in voltage test mode.
High V:	Full battery voltage in volts. This is used to define the full position on the battery voltage indicator on the display.
Warn V:	This is the battery voltage in volts that will be used to trigger the low battery voltage warning display.

Low V: This is the low battery error level that will trigger the do not fly error message and define the empty position on the battery voltage indicator.

These values can be changed using the PC interface and utility program. The Load R resistance value must match the value of the resistor used in the MAESTRO for proper operation.

Two sets of parameters are used by the MAESTRO, one for voltage profile A and another of profile B. Mode 7 will display the parameters for profile A and mode 8 will display the parameters for profile B.

Manufacture (Mode 9)

When the manufacture mode is selected MAESTRO will display contact information for me, the developer of this device. This will allow you to contact me or my web site if you should lose your documentation or forget how to contact me. Below is an example of what will be seen on the display:

Record (Mode 10)

The record mode allows MAESTRO to record the battery voltage and save the values in its internal memory. A total of 300 readings can be recorded and saved before its memory is full. The time between each voltage reading can also be defined. This allows you to determine how long the MAESTRO can record voltages before its memory is full. When the internal buffer fills the display will display "FULL".

This voltage recording mode will allow you to place the MAESTRO in your aircraft and record the voltage during a flight. The voltage data, saved in the MAESTRO's internal memory, will be lost if power is removed. After the data recording has completed you must connect the

MAESTRO to your PC and use the Maestro PC application to read the voltage data, display the results, and save the data to a file. This can be done by plugging one of MAESTRO's connectors into the PC interface and connecting the interface to you PC's comm port. This must all be performed without removing power to insure the data is retained. MAESTRO has two cables and either one can be used to monitor the voltage or connect to the PC interface.

When MAESTRO is in the record mode, it will start recording data as soon as power is applied. The display will show the battery voltage during the recording process.

The PC application can be used with the MAESTRO to record voltage data and display the data as its read. In this mode the number of data points that can be collected is virtually unlimited. This mode is useful for monitoring the battery voltage during charge and discharge cycles.

Configuration Utility

The Maestro PC application will allow you to define all of the adjustable parameters using a simple Windows application. The installation files are included on the CD that comes with your MAESTRO. In order to use this application you will need the Serial Interface option. The picture below shows how to connect the MAESTRO to the Serial Interface and to your PC.
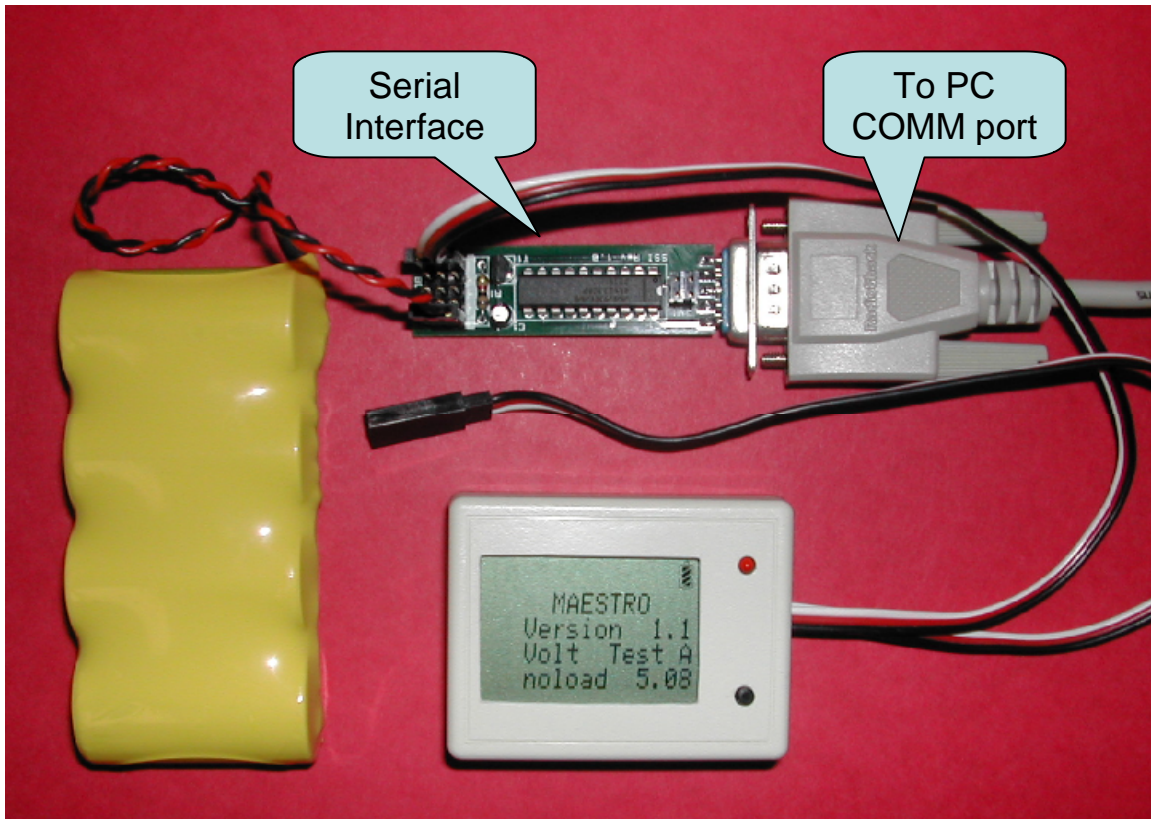
After you have completed the connections and your MAESTRO is powered up, start the PC application. You will see the following dialog box on your PC as the program tries to make contact with MAESTRO. This message will disappear as soon as connections are established. This dialog box may flash by so fast that you do not even notice it.
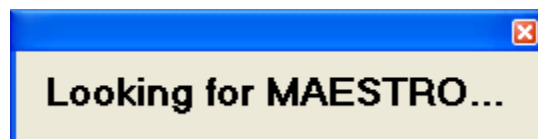
If connection cannot be established after a few seconds you will see the following error dialog box:

This indicates the connection could not be made. Press OK and then check your connections. This message could occur if you are not connected to the expected communications port. After you press OK the application will start and you can use the Comms menu option to try a different port.

After the application starts you will see the main application dialog box as shown below:

This application has six tabs that allow you to define all adjustable parameters and even download a new program to the Maestro. To change an entry just point to a parameter you wish to edit and type in the new value. Press enter after you have made your changes

and the data will be sent to MAESTRO. The Refresh menu option will cause the application to re-read all parameters from MAESTRO. After you have made changes to any of the parameters make sure and save the changes to EEPROM using the button in the Misc tab.

The servo cycle tab allows you to define the servo positions saved in the cycle table. Up to 10 values can be saved in this table. Each entry is in micro-sec and this defines the servo position. 1000 to 2000 micro-sec defines the normal range of servo motion with 1500 micro-sec representing center. The dwell time value is used in the automatic advance mode, this time defines how long the servo will stay, "dwell" at each servo position. When a 0 is entered in the table it represents the end of the list and the MAESTRO will reset to the top of the list when a zero is encountered.
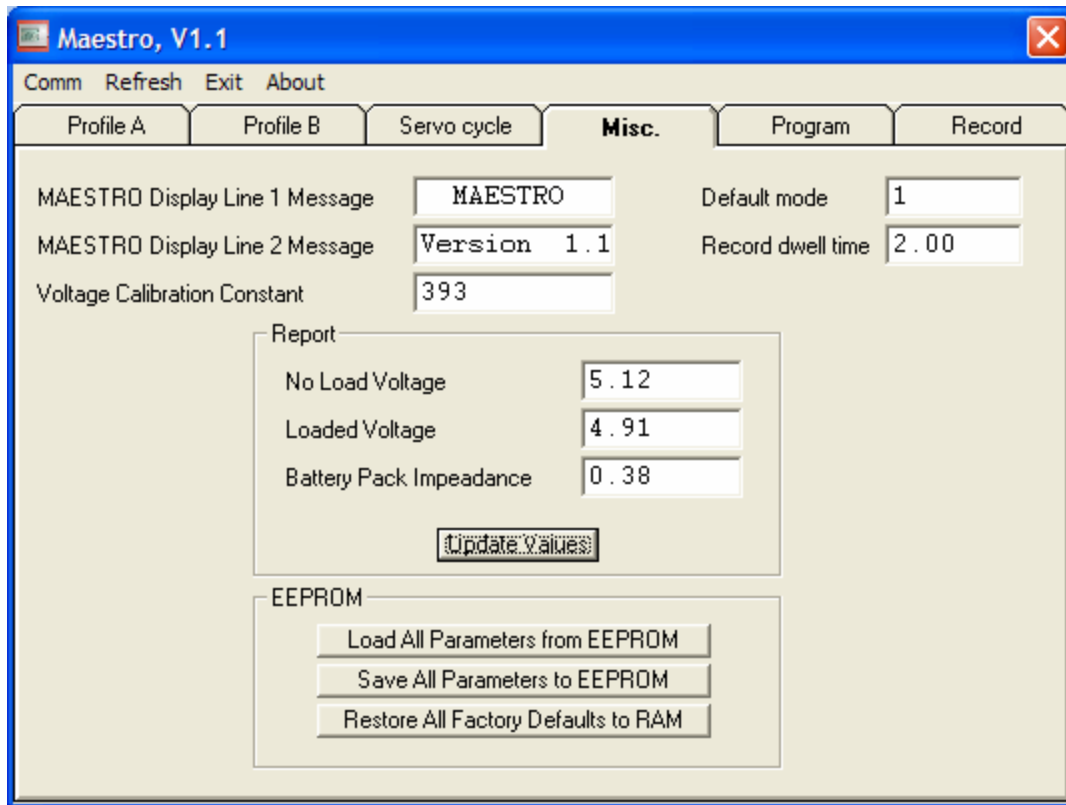
The Misc tab allows you to define the title messages found on the MAESTRO. This will allow you to personalize your system. You can define the default mode entered by MAESTRO when power is applied. The record dwell time is the number of seconds between voltage samples when in the voltage record mode. This dialog box also contains the EEPROM controls. Make sure you press the Save All Parameters to EEPROM button after you have finished making your changes. This button will write the changes to non-volatile storage in the MAESTRO. If you do not press this button all changes will be lost when power is removed.

The voltage calibration constant is used to calibrate the voltage display on the MAESTRO. This has been set at the factory and should not require adjustment. If you expect an accuracy problem with your MAESTRO you can return it to the factory for a free calibration. Recalibration of the MAESTRO will require an accurate digital voltmeter. To recalibrate the MAESTRO please use the following procedure:

1.) Connect the MAESTRO to your PC using the serial interface.
2.) Connect a calibrated volt meter to the power pins on the serial interface.
3.) Connect a battery to the serial interface.
4.) Start the MAESTRO program on your PC and establish communications.
5.) Select the Misc tab after the application starts.
6.) Adjust the voltage calibration constant until the MAESTRO voltage matches the calibrated voltmeter.
7.) Press the save all parameters to EEPROM button when finished, to save your changes.

If you press the restore factory defaults button you will have to recalibrate the MAESTRO. The factory defaults contain typical calibration constants. Each MAESTRO is calibrated before leaving the factory.
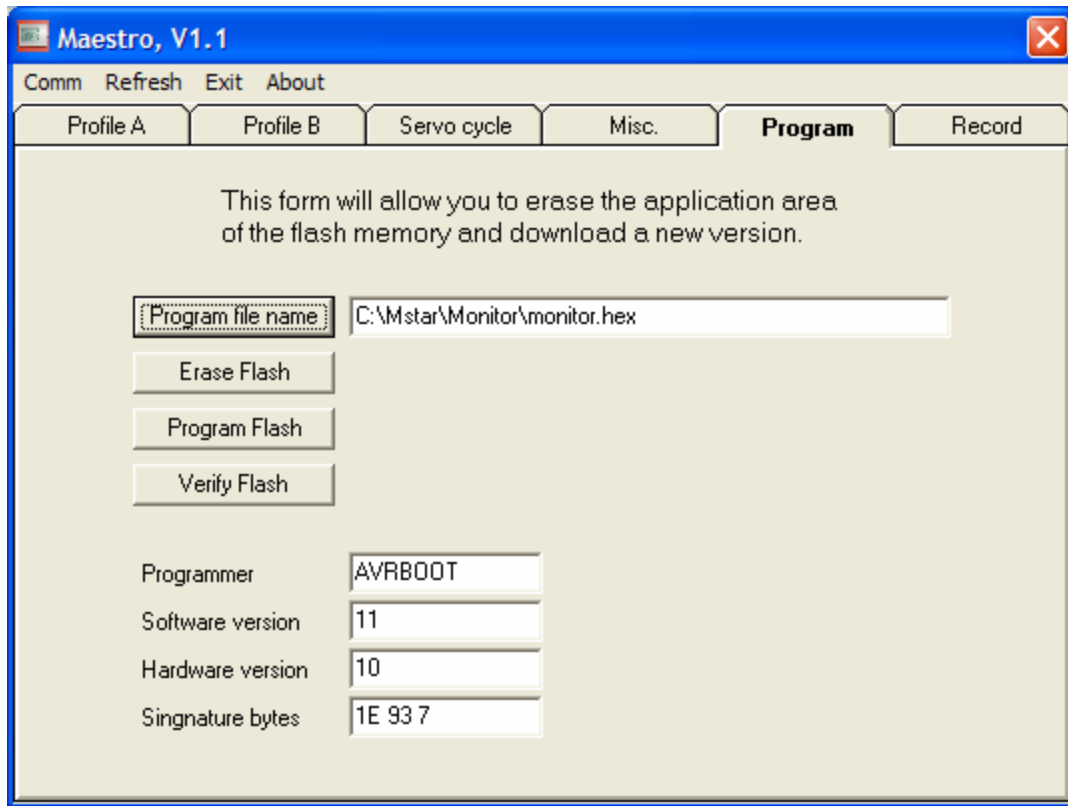
Pressing the Program tab will place MAESTRO in the programming mode. This mode allows you to erase the application program and replace it with your own version or update the firmware when new versions are available. **Warning**! Entering this mode will reset the MAESTRO and you will lose all changes you have made if you do not first press the save changes to EEPROM button in the Misc tab. **Warning**! Pressing the Erase flash button will erase the MAESTRO application rendering the unit useless; you will need to program the flash with a new application if you erase the flash. This option is intended for advanced users who wish to reprogram the MAESTRO, you can even write you own application if you wish. To program a new application in the MAESTRO please perform the following steps:

1.) Press the program file name button and use the file selection dialog box to select a hex file to program. The CD that comes with MAESTRO contains monitor.hex, the programmed in MAESTRO when shipped from the factory.
2.) Press the erase button to clear the flash memory.
3.) Press the program flash to place the new program in flash.
4.) Press the Verify Flash button to validate the program in flash.

That's it! You are now ready to test your new program. Pressing any new tab selection will restart MAESTRO with your new application.
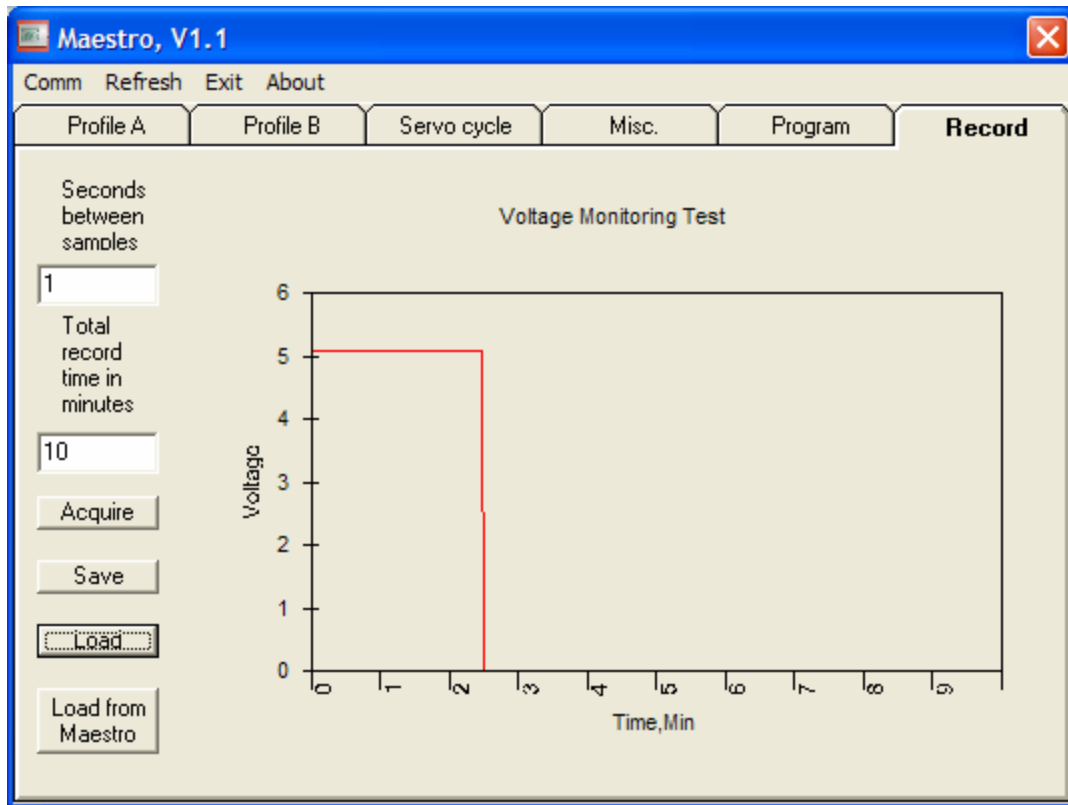
The record mode allows you to monitor and save the battery voltage as a function of time. This will allow you to monitor the battery voltage as you discharge your batteries or has you charge them. There are two modes of record operations, standalone and real-time. Each mode is discussed below:

Standalone

The standalone mode is used when the MAESTRO is placed in the Record mode. In this mode the battery voltage is recorded and saved in its internal memory. 300 data values can be saved and then the memory is full.

Real-time

The real-time mode is only possible when connected to your PC. In this mode each data point is recorded by the PC and shown on the plot. You can sale this data to a file that can later be loaded and displayed or even loaded into a program like Excel. This mode allows you to record a larger number of data points that can be saved in the MAESTRO. The dialog boxes on this tab allow you to define the length of time you wish to record and the number of seconds between voltage readings.

This load from MAESTRO button allows you to download and display any voltage data saved in memory.

Command set

The MAESTRO communications is a simple RS232 ASCII interface. The hardware uses one signal line for both transmit and receive half duplex. Thus only one device can transmit at a time. MAESTRO will never transmit unless it receives a command that requires a response. Every command starts with a device address character that can be user defined; this allows several devices to be connected to one controller in a multi-drop configuration.

Each command is three characters long and some commands have a required argument. Listed below is a list of all valid commands and a very brief description, default values are shown in parenthesis:

Command	Description	Default
Calibration commands		
DID	Display ID message	("Maestro V1.1")
DMD	Define default mode	(1)
DRD	Define record dwell time	(3.0)
DVC	Define voltage calibration	(~393)
DM1	Define message line 1	(" MAESTRO ")
DM2	Define message line 2	(" Version 1.1 ")
DCY	Define Cycle table values	(1000,1500,2000,1500,0)
DDT	Cycle dwell time	(2.0)
DVD	Voltage load dwell time	(30)
Voltage profile A		
DVA	Define volt profile A name	("4 cell NiCd")
DRA	Define load resistance	(10.0)
DHA	High voltage set	(5.0)
DWA	Warn voltage level	(4.6)
DLA	Low voltage level	(4.4)
Voltage profile B		
DVB	Define volt profile B name	("2 cell Li-po")
DRB	Define load resistance	(7.5)
DHB	High voltage set	(8.4)
DWB	Warn voltage level	(6.5)
DLB	Low voltage level	(6.0)
EEPROM commands		
ELD	Load from EPRROM	
ERD	Restore defaults	
ESV	Save in EEPROM	
Report commands		
RDB	Report data buffer	
RDC	Report data point count	
RNV	No load voltage	
RLV	Loaded voltage	
RIM	Cell impedance	

Each command is preceded by the device's address character. The default address character is '1'. Commands that are sent with an address character of 'X' will be processed by all devices. Devices will not answer commands that are received with the 'X' address character. This is to prevent multiple devices from trying to talk at the same time. Devices will only respond when they receive a command with their specific address.

The commands and the address characters are case sensitive. The interface does not support the backspace key for error corrections. All commands are terminated with a carriage return <CR>, line feed <LF> characters are ignored. Commands that accept input arguments are not range tested, so entering an out of range value can cause unpredictable results. This interface is primarily designed for the Maestro PC application to control the device, thus it is not very user friendly!

Any command received by the device that starts with the valid address will result in a response from the device. A <CR> <LF> will indicate the command was processed and understood. A '?' <CR> <LF> indicates the command was not recognized. If the command requires a response it will be sent before the <CR> <LF>.

The RS232 interface is fixed at 9600 baud no parity and 1 stop bit. The interface is a logic level low true interface.

Below is an example of a valid command to read the voltage level:

1RNV<CR><LF>

Here is an example response:

4.78<CR>

On the following pages each command will be discussed in detail. All commands will be shown with the default device address of '1'. X indicates an input argument and its range will be defined for each command.

DID

Device identification command

> **Format:** 1DID<CR>   Causes device to its ID string.
>
> **Description:** This command causes the device to return its identification string. The following string will be returned when this command is entered:
> > Maestro V1.1

DMD   (1 to 10)

Define the default mode

Format: 1DMD<CR>   Causes device to return current mode.
               1DMD X<CR>   Defines the default mode.

Range: X = 1 to 10

Description: This command is used to define the default mode for the
                 MAESTRO. This is the operating mode that the system will enter
                 when power is first applied. The following table lists the valid
                 modes:
                 1   Voltage test A
                 2   Voltage test B
                 3   High low voltage monitor
                 4   Pulse width monitor
                 5   Servo cycler
                 6   Servo position control
                 7   Display parameters A
                 8   Display parameters B
                 9   Display manufacture
                 10   Voltage record

DRD   (0.1 to 100.0)

Define record dwell time

Format: 1DRD<CR>   Causes device to return current value.
               1DRD X<CR>   Defines record dwell time.

Range: X = 0.1 to 100.0

Description: This command defines the record mode dwell time in seconds. The
                 dwell time defines the time between samples when the MAESTRO
                 is in the record mode. In this mode the battery voltage is saved in
                 internal ram for later downloading to the PC application. A
                 maximum of 300 samples can be recorded, thus the maximum
                 recording time is the dwell time multiplied by 300.

DVC   (250 to 1000)

Voltage calibration command

Format:	1DVC\<CR\>	Causes device to return current value.
	1DVC X\<CR\>	Defines calibration value.

Range: X = 250 to 1000

Description: This command is used to calibrate the voltage display. This is set
at the factory and should never require adjustment. In the event
that you need to re-calibrate the system use the following
procedure. You will need an accurate digital voltmeter to perform
this procedure.

1.) With the MAESTRO attached to the serial interface and your
PC. Use a volt meter to monitor the value of the MAESTRO's
power source.

2.) Use the DVC command and adjust the value until the
MAESTRO's displayed voltage matches voltmeter.

DM1   (" MAESTRO ")

Define first display line message

Format:	DM1 \<CR\>	Displays current message.
	DM1 X\<CR\>	Defines a new message.

Range: X = (12 character message string)

Description: This command allows the user to define the message displayed on
the first line of the display. You can enter any 12 character string
you desire.

DM2   (" Version 1.1 ")

Define second display line message

Format:	DM2 \<CR\>	Displays current message.
	DM2 X\<CR\>	Defines a new message.

Range: X = (12 character message string)

Description: This command allows the user to define the message displayed on
the second line of the display. You can enter any 12 character
string you desire.

DCY   (1000,1500,2000,1500,0)

Defines the servo cycle positions

| **Format:** | 1DCY Y <CR> | Displays the selected servo position. |
| | 1DCY Y X<CR> | Defines the selected servo position. |

| **Index:** | Y = 0 to 9 | Selects the desired servo position. |

Range: X = 1000 to 2000

Description: This command allows the user to define the servo cycle mode positions. The positions are defined in pulse widths in micro-sec units. Normal servo positions are defined by a pulse whose width varies from 1000 micro-sec to 2000 micro-sec with the center being defined at 1500 micro-sec. The servo cycle mode contains 10 possible positions that can be defined with this command. If you wish to terminate the list with less than 10 entries, enter 0 in the first unused location. This will cause the cycle mode to reset to the first entry in the table.

DDT (2.0)

Define servo dwell time command

| **Format:** | 1DDT <CR> | Displays the current dwell time. |
| | 1DDT X<CR> | Defines the servo dwell time. |

Range: X = 0.0 to 100.0

Description: The servo cycle mode automatically advances the servo between each position in the sample table. This command allows you to define the length of time, in seconds, that the servo will spend at each position.

DVD (30)

Voltage load dwell time command

| **Format:** | 1DVD <CR> | Displays the current dwell time. |
| | 1DVD X<CR> | Defines the voltage load dwell time. |

Range: X = 0.0 to 100.0

Description: This command defines the maximum time, in seconds, that the load will be applied to the battery under test. MAESTRO will automatically remove the load after this length of time.

DVA,DVB ("4 cell NiCd"), ("2 cell Li-po")

Define the voltage profile name

Format:	1DVA<CR>	Displays the voltage A profile name.
	1DVA X<CR>	Defines the voltage A profile name.
	1DVB<CR>	Displays the voltage B profile name.
	1DVB X<CR>	Displays the voltage B profile name.

Range: X = (12 character message string)

Description: This command allows you to define the voltage profile names. This name is displayed on the third line of the display and you can use this to identify the type of batteries being tested.

DRA,DRB   (10),(7.5)

Define the load resistance

Format:	1DRA <CR>	Displays voltage profile A's load.
	1DRA X<CR>	Defines voltage profile A's load.
	1DRB<CR>	Displays voltage profile B's load.
	1DRB X<CR>	Defines voltage profile B's load.

Range: X = 5.0 to 100.0

Description: This command allows you to define the load applied to the battery when the loaded voltage is measured. This load determines the current that will be drawn from the battery under load. The current is $I = V/R$, where I is the current in amps, V is the voltage in volts, and R is the load resistance in ohms.

DHA,DHB   (5.0),(8.4)

Define the high voltage level

Format:	1DHA <CR>	Displays profile A's high voltage value.
	1DHA X<CR>	Defines profile A's high voltage value.
	1DHB<CR>	Displays profile B's high voltage value.
	1DHB X<CR>	Defines profile B's high voltage value.

Range: X = 0.0 to 20.0

Description: This value is used to define the "full" level on the battery level icon found in the upper right corner of the display. This icon gives you a rapid visual indication of the battery condition.

DWA,DWB   (4.6),(6.5)

Define the warn voltage level

Format:	1DWA <CR>	Displays profile A's warn voltage.
	1DWA X<CR>	Defines profile A's warn voltage.
	1DWB<CR>	Displays profile B's warn voltage.
	1DWB X<CR>	Defines profile B's warn voltage.

Range: X = 0.0 to 20.0

Description: When the battery voltage falls below the warn voltage level
MAESTRO will display the following message:

Warning!
Low Battery

This message provides a visual warning that it is time to charge
your batteries!

DLA,DLB (4.4),(6.0)

Define the low voltage level

Format:	1DLA <CR>	Displays profile A's low voltage.
	1DLA X<CR>	Defines profile A's low voltage.
	1DLB<CR>	Displays profile B's low voltage.
	1DLB X<CR>	Defines profile B's low voltage.

Range: X = 0.0 to 20.0

Description: This low voltage level is used to set the empty level on the battery
icon found in the upper left corner of the display. When the
battery voltage falls below the low level MAESTRO will display
the following message:

Do not fly
Charge Batt!

This message warns you that it is unsafe to fly, recharge now!

ELD

Load operating parameters from EEPROM

Format: 1ELD <CR>

Description: The EEPROM is used to store all programmable parameters. This
command will load the values, currently stored in EEPROM, into
the MAESTRO. This will cause any parameters you have changed

to be over written. This operation happens automatically each time the system is powered up.

ERD

Load default parameters

    Format: 1ERD <CR>

    Description: This command is used to restore all of the factory default operating parameters. These parameters will be copied to the MAESTRO's memory after issuing this command. To save these values make sure and use the ESV command.

ESV

Save operating parameters to EEPROM

    Format: 1ESV <CR>

    Description: All MAESTRO operating parameters are saved in EEPROM. This is non-volatile memory that is read every time power is applied to the system. After you make any changes you must use this command to permanently save the changes, if you do not use this command then you will lose your changes as soon as you remove power from the device.

RDB

Report the voltage data buffer

    Format: 1RDB <CR>

    Description: This command will report the data in the voltage data buffer. This buffer contains each voltage point recorded by the MAESTRO when in the record mode. A maximum of 300 values will be returned and a minimum of 0. Use the RDC command to determine how many values are in the buffer before sending this command. Each value will be printed along with a <CR> <LF> end of line character.

RDC

Report the data buffer count

Format: 1RDC <CR>

Description: This command will report the number of values in the voltage data buffer. This data buffer is used to save voltage values when the MAESTRO is in the record mode.

RNV

Report the no load voltage

    Format: 1RNV <CR>

    Description: This command will report the last measured no load voltage.

RLV

Report the loaded voltage

    Format: 1RLV <CR>

    Description: This command will report the last measured loaded voltage.

RIM

Report the battery pack impedance

    Format: 1RIM <CR>

    Description: This command will report the last calculated battery pack impedance.

Specifications

Size:	1.85" x 2.40"
Weight:	2 oz
Operating temperature range:	$-10^{O}C$ to $50^{O}C$
Current consumption:	9 mill-amps at 5.00 volts
Load resistance range:	5.0 to 1000 ohms
Voltage range:	3.0 to 14.5 volts
Voltage resolution:	0.01425 volts
Voltage accuracy:	+- 0.007125 volts
Pulse width monitoring resolution:	0.000001 seconds
Pulse width monitoring accuracy:	+- .0000005 seconds
Pulse width generation resolution:	0.000001 seconds
Pulse width generation accuracy:	0.01%

Ordering

The MAESTRO system is available for **$49.95**. The following items are included with each system:

> 1 – MAESTRO
> 1 – Male to male connector adapter
> 1 – CD containing the documentation and PC application

Please compete the MAESTRO order form when placing an order, your options will be set at the factory and your personal setting will be defined at the factory.

The serial interface is required if you would like to configure the MAESTRO yourself. This interface is available for **$14.95**.

Please include **$5.00** for shipping and handling.

Warrantee

The MAESTRO has a one year parts and labor warrantee.

Contact information

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